Improving fruit soluble solids content in melon (*Cucumis melo* L.) (reticulatus group) in the Australian production system

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Abstract

Total soluble solids (TSS) is a reliable indicator of melon eating quality, with a minimum standard of 10% recommended. The state of Australian melon production with respect to this quality criterion was considered within seasons, between growing districts and over seasons. It was concluded that improvement in agronomic practice and varietal selection is required to produce sweeter melons. The scientific literature addressing melon physiology and agronomy was summarised, as a background to the work that is required to improve melon production practices in Australia.

The effect of source sink manipulation was assessed for commercially grown and glasshouse grown melon plants. The timing of fruit thinning, pollination scheduling, the application of a growth inhibitor and source biomass removal were assessed in relation to fruit growth and sugar accumulation. Results are interpreted against a model in which fruit rapidly increase in weight until about two weeks before harvest, with sugar accumulation continuing as fruit growth ceases. Thus treatment response is very dependant on timing of application. For example, fruit thinning at 25 days before harvest resulted in further fruit set and increased fruit weight but did not impact on fruit TSS (at 9.8%, control 9.3%), while thinning at 5 days before harvest resulted in a significant ($P<0.05$) increase in fruit TSS (to 10.8%, control 9.3%) and no increase in fruit weight or number. A cost/ benefit analysis is presented, allowing an estimation of the increase in sale price required to sustain the implementation of fruit thinning.

The effect of irrigation scheduling was also considered with respect to increasing melon yield and quality. To date, recommended practice has been to cause an irrigation deficit close to fruit harvest, with the intent of "drying out" or "stressing" the plant, to "bring on" maturity and increase sugar accumulation. Irrigation trials showed that keeping plants stress-free close to harvest and during harvest, facilitated the production of sweeter fruit.

The maintenance of a TSS grade standard using either batch based (destructive) sampling or (non-invasive) grading of individual fruit is discussed. On-line grading of individual fruit is possible using near infrared spectroscopy (NIR), but the applicability of the technique to melons has received little published attention. Tissue sampling strategy was optimised, in relation to the optical geometry used (in commercial operation in Australia), both in terms of the diameter and depth of sampled tissue. NIR calibration model performance was superior when based on the TSS of outer, rather than inner mesocarp tissue. However the linear relationship between outer and middle tissue TSS was strong ($r^2 = 0.8$) in immature fruit, though less related in maturing fruit ($r^2 = 0.5$). The effect of fruit storage (maturation/senescence) on calibration model performance was assessed. There was a negligible effect of fruit cold storage on calibration performance.

Currently, the agronomist lacks a cost-effective tool to rapidly assess fruit TSS in the field. Design parameters for such a tool were established, and several optical front ends compared for rapid, though invasive, analysis. Further, for visualisation of the spatial distribution of tissue TSS within a melon fruit, a two-dimensional, or hyper-

spectral NIR imaging system based on a low cost 8-bit charge coupled device (CCD) camera and filter arrangement, was designed and characterised.

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Declaration

I declare that this thesis is an original work and no part of this thesis has been previously submitted for the award of another degree.

I also declare that to the best of my knowledge any assistance I received in the experimentation presented in this thesis and all sources of information used in this thesis have been acknowledged.

Robert Long

Abbreviations

ABS	absorbance
ADC	analogue to digital conversion
AMA	Australian Melon Association
ANOVA	analysis of variance
cbar	centibars
CCD	charge coupled device
cf.	confer (compare)
cv.	cultivar variety
d	days
d^2ABS	second derivative absorbance
DAA	days after anthesis
DBH	days before harvest
DW	dry weight
e.g.	*exempli gratia* (for example)
Fig.	Figure
FW	fresh weight
HI	harvest index
i.e.	*id est* (that is)
LSD	least significant difference
LWR	leaf weight ratio
MLR	multiple linear regression
msec	milliseconds
n	number
NIR	near infrared
NSW	New South Wales
PAR	photosynthetic active radiation
PC	principle component
PDA	photodiode array
PLS	partial least squares
QDPI	Queensland Department of Primary Industries
QLD	Queensland
r^2	coefficient of determination
R^2	coefficient of determination (NIR calibrations only)
RCBD	randomised complete block design
RH	relative humidity
RMSECV	root mean standard error of cross validation
RMSEP	root mean standard error of prediction
s/n	signal to noise ratio
SD	standard deviation
SDR	standard deviation residual
SE	standard error
SW-NIR	short wave near infrared
TSS	total soluble solids
vs.	versus
WA	Western Australia